EVS 20
Powering Sustainable Transportation

California Environmental Protection Agency
AIR RESOURCES BOARD

1990: Initial Focus- Battery EVs

- "The staff anticipates that all ZEVs will be powered by electricity" 8/13/90 Staff Report
- Vehicle components
  - Motors (brushless DC and AC induction)
  - Controllers (inverter+)
    - Power electronics
- Batteries
  - Advanced lead-acid
  - Sodium sulfur
  - Nickel metal hydride
  - Lithium ion and polymer
  - Sodium nickel chloride ("Zebra")

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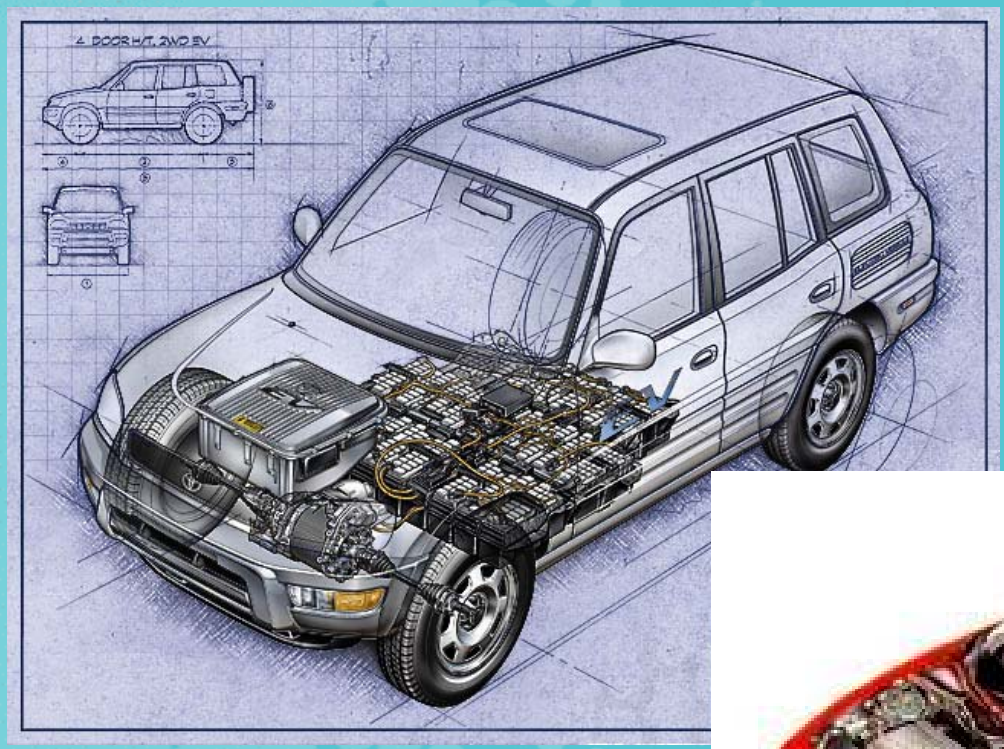

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1991: US Advanced Battery Consortium

- Formed in January 1991
- USABC - part of the US Center of Automotive Research (US CAR)
- Mission: To pursue research and development of advanced energy systems capable of providing future generations of electric vehicles with significantly increased range and performance.
- No funding for advanced lead-acid batteries

1991: USABC Goals

- Establish the technical capability for advanced battery manufacturing in the United States for electric vehicles
- Accelerate the market potential of electric vehicles by supporting research and development of the most promising advanced battery alternatives.
- Develop electrical energy systems capable of providing electric vehicles with range and performance competitive to gasoline-powered vehicles.

  (150 miles range at ICE vehicle cost)
- Leverage funding for high-risk, high-cost, advanced battery research and development for electric vehicles.

1993: GM PrEView Program

- GM launched the Impact prototype test-drive program (PrEView)
- Intended to gather real-world driving and charging data
- Available for loan to public in 12 selected cities
- 14 utility partners acted as program managers
- 500+ drivers
- 300,000+ miles accumulated

1993: Partnership for a New Generation of Vehicles

- PNGV initiated in September 1993
- Emphasized research and development programs designed to triple fuel efficiency
- Goal to culminate in the production of prototype family autos in 2004
- Technologies would be incorporated into more efficient production vehicles about four years later
- Restructured to FreedomCar program in January 2002

1995: ARB Battery Panel Review

- Lead-acid available but performance less than needed
- Promising advanced battery developments worldwide
- Pilot-scale production necessary to prove-out production processes
- Best case: commercial introduction of advanced battery vehicles in 2000 or 2001

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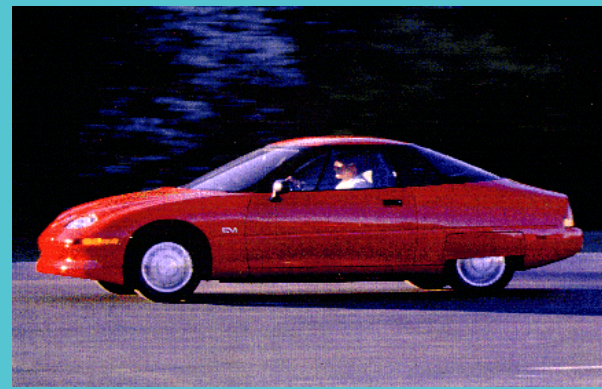
1996 ZEV Regulation

10 % ZEVs in 2003



1996: ZEV Amendments

- Early requirements (1998-2002) eliminated
- ARB established agreements with large automakers to place technology demonstration fleet ("MOA" Vehicles):
  - Advanced batteries encouraged
  - ~ 1,800 vehicles expected
- Support activities
  - Infrastructure
  - Codes and standards
  - Emergency response
  - Battery research & development
- ZEV regulation now ~3 pages long

1996+: MOA EVs

- In general, these EVs were very successful in operation- EVs had come a very long way.
- Automakers claimed marketability challenges
- Design distinctions:
  - Most of those with reasonable performance made use of advanced batteries,

    except the Panasonic EV1
  - All used 2-4 x the energy per mile as a Panasonic EV1